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EXPERIMENTAL EVALUATION OF ATMOSPHERIC EFFECTS  
ON RADIOMETRIC MEASUREMENTS USING THE EREP  
OF SKYLAB. (EPN No. 439)  
Contract No. NAS 9013343

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EXPERIMENTAL EVALUATION OF ATMOSPHERIC EFFECTS  
ON RADIOMETRIC MEASUREMENTS USING THE EREP OF SKYLAB

1. Program Summary

The purpose of this study is to evaluate the effects of the atmosphere on radiometric measurements using the EREP of SKYLAB. In particular, the effects of atmospheric attenuation in the visible and near infrared spectral regions evidenced in EREP. S192 multispectral imagery is to be evaluated on the basis of atmospheric modeling. If possible a simple monograph for estimating absolute and differential atmospheric effects based on a finite set of atmospheric and surface parameters is to be suggested. The primary data source in this study will be CCT's of the GMT correlated S192 instrument aperture radiances.

In previous reporting periods, the following tasks have been completed or finalized:

- a) Target selection criteria of area, homogeneity and "flatness" have been applied to S192 screening film and S190A and S190B imagery to select digital GMT segments of S192 radiance in the two primary test sites for further analysis. These are:

EREP Pass 2 (2 June 1973)

GMT Time Interval: 200822.0 GMT  
Location: 33.5N, 116.0W (Salton Sea)  
Channels: 2,3,4,5,6,7,8,9,10,11,12

EREP Pass 5 (5 June 1973)

1. Segment A

GMT Time Interval: 175737.0 - 175742.0 GMT  
Location: 40.7N, 113.8W (Bonneville Salt Flat)  
Channels: 2,3,4,5,6,7,8,9,10,11,12

2. Segment B

GMT Time Interval: 175810.0 - 175814.0 GMT  
Location: 39.3N, 111.4W (Wasach Range)  
Channels: 2,3,4,5,6,7,8,9,10,11,12

EREP Pass 39 (13 September 1973)

1. Segment A

GMT Time Interval: 193404.3 - 193407.0 GMT  
Location: 40.7N, 113.8W (Bonneville Salt Flat)  
Channels: 2,3,4,5,6,7,8,9,10,11,12

2. Segment B

GMT Time Interval: 193421.7 - 193424.2 GMT  
Location: 41.25N, 112.6W (Great Salt Lake)  
Channels: 2,3,4,5,6,7,8,9,10,11,12

3. Segment C

GMT Time Interval: 193416.8 - 193418.9 GMT  
Location: 41.1N, 113.0W (Desert)  
Channels: 2,3,4,5,6,7,8,9,10,11,12

EREP Pass 43 (15 September 1973)

1. Segment A

GMT Time Interval: 180504.7 - 180505.9 GMT  
Location: 33.3N, 115.9W (Salton Sea)  
Channels: 2,3,4,5,6,7,8,9,10,11,12

2. Segment B

GMT Time Interval: 180501.5 - 180503.7 GMT  
Location: 33.2N, 116.1W (Desert)  
Channels: 2,3,4,5,6,7,8,9,10,11,12

- b) An inventory of the surface characteristics of selected S192 segment targets was completed utilizing S190A imagery as base maps (prepared in 1:250,000 scale for the Salton Sea area and 1:1,000,000 scale for the Great Salt Lake area). Overlays of S192 nadir position vs. GMT, geological, topographic, and mineralogical features were prepared.
- c) Software was developed to implement the necessary theoretical analysis.

2. Progress During the Reporting Period

- a) SL2 Ground Truth

Ground truth was available for the Great Salt Lake Desert, Utah, in publication "Ground Truth Data for Test Sites (SL-2)" [NASA-JSC, 1973]. This site was not within the requested Bonneville Salt Flat region, but is contiguous to the Great Salt Lake. An additional CCT digital segment for the GMT time of the site overpass (EREP Pass 5, Ground Track 34, Rev. 318/319; GMT 156:17:57:45) of the S192 GMT correlated aperture radiances was requested. Preliminary analysis of the collected ground truth data was performed.

Surface measurements of atmospheric optical depth using an ISCO Spectroradiometer were compared with theoretically generated results for a summer midlatitude atmosphere with a continental haze model and a 23 Km visibility. The theoretical calculation consistently underestimated the transmissivity:

- i. in the near infrared  $H_2O$  rotational-vibrational bands ( $.94 \mu m$ ), there is clear evidence for less  $H_2O$  vapor in the actual atmosphere than in the model. This is understood.
- ii. the continuum level due to aerosol absorption in the in situ measurement appears to be too high compared with the model. Observers reported that ground conditions were "hazy" while the model is essentially clear. The model should overestimate the transmissivity in the aerosol continuum. This discrepancy is not yet understood.

Measurements of the surface reflectance spectrum for bidirectional and hemispheric reflectance indicate that the test site surface is non-Lambertian. For a Lambert reflector, the ratio of hemispheric to bidirectional reflectance should be  $\pi$ . For the desert target surface, this quantity appears to be approximately 1.25 (i.e., too low). This indicates that there is an appreciable specular component of reflection. If our targets are indeed not Lambert reflectors, the final theoretical analysis must be amended.

#### b) Theoretical Analysis

Work has continued to refine the theory used to model atmospheric transmission properties.

c) Submission of Abstract

A short abstract describing the nature of this study and the theory to be implemented was submitted to the AIAA/AGU Space Science Conference on SKYLAB to be held in October, 1974. No significant results are discussed and the final results to be presented will be dependent on the receipt of digital data for analysis prior to the conference. The abstract appears as an Appendix to this report.

d) This group cooperated with Mr. James C. Barnes (Principal Investigator, EREP Investigation No. 420) in studying an S192 digital tape received for his work. Difficulties in understanding the processed data and seeming inconsistencies were cataloged.

e) A number of telephone discussions were exchanged with this study's technical monitor, primarily on the subject of data receipt.

3. Problems

The analysis to be performed in this study requires digital values of S192 aperture radiances as the primary data set. Due to processing difficulties, we have been informed that data will be available at the earliest in late June. Simulated S192 radiances from the ERAP ground truth flyover of the Salton Sea region, will not be available until January, 1975. It will therefore, not be possible to complete this study within the scheduled time period ending 30 June 1974. The Technical Monitor (or PIMO) have been notified of this problem. We have been assured verbally that plans are underway for the extension of the contract period to beyond the current 30 June termination date.

4. Future Plans

Analysis will commence immediately upon receipt of the first S192 CCT's. Travel to NASA-GSFC, Greenbelt, Maryland, is anticipated during the next reporting period for the purpose of conferring with Dr. Robert Fraser on the use of his path radiance calculations.